

-Summary Panel Final Report-

Program Review of Data Used in California Current Groundfish Stock Assessments

Northwest Fisheries Science Center

The National Marine Fisheries Service's Northwest Fisheries Science Center (NWFSC) in Seattle, WA conducted an external review to evaluate its current scientific data gathering and management procedures. This review focused on fishery-independent data, fishery-dependent data, biological data, quality control, and data management as they relate to fishery stock assessments. The review was conducted over a 4-day period during which Center staff provided presentations to a 6-member panel, open to partners, constituents, and the public. Prior to the meeting, supplementary material in the form of a CD and web access, provided in-depth detail on Center operations. The reviewers provided oral feedback to the Center Director at the end of the meeting and were tasked with providing written reports contained herein. Following is a summary of the major findings and recommendations of Panel members.

I. Overview of Review Meeting

Panel members acknowledged the high caliber and depth of expertise, and significant creativity among the staff from the NWFSC and SWFSC and their state and PSMFC partners. All should be commended for their work and extraordinary efforts to provide the fishery independent and dependent data needed to support West Coast groundfish stock assessments and management. The presentations during the review showed clearly the impressive extent and high quality of those efforts and the dedication of the staff involved.

Panel members said that the relationship of current and planned fishery assessment data activities to support fisheries stock assessments seems to be in general on the right track. The data collection programs currently support the assessment of the 91+ species of groundfish to varying degrees and generally appear to meet the needs of the most important commercial species managed by the PFMFC. Panel members said that NWFSC staff is using the best available techniques and approaches for modern stock assessments and overall, limitations and weaknesses seem to be mostly related to available resources.

Nonetheless, Panel members also said that it is apparent that there are a number of areas throughout the data collection programs that need examination and improvement, such as additional study on survey planning, assessment priority, and

leveraging existing and developing technologies. Opportunities should be pursued to improve the infrastructure for the database systems and enhance collaboration with neighboring science centers and other research institutions. The current and future uncertainty of budget, personnel and ship resources make it especially important that cooperation and coordination occur between all the partners involved and from NMFS on a national level to accomplish this in an informed and effective way.

II. Panel Members' Major Findings and Recommendations

- **Resource allocation.** Panel members noted a systematic lack of adequate allocation of resources to accomplish all the survey data objectives. This observation is common throughout the portfolio of programs. Panel members said that there is a need to prioritize mission objectives and to allocate resources to where they will make the most difference. While Center leadership is aware of its basic core mission, it is less clear how monitoring programs would be restructured for viability in future budget reductions.
- **Culture.** Panel members perceived a somewhat insular culture operating within the groundfish program that inhibits collaboration in contrast to other component programs that do have a culture of collaboration. Changing culture is not easy or simple and management needs to resolve the balance between:
 - engaging the survey teams into the science and research enterprise as active, valued and rewarded members and
 - making it clear that the survey team is there to provide data to the other teams

Panel members noted that Management has initiated efforts to engage research teams and this is encouraging.

- **Leadership.** Given the geographic range and number of groundfish data collection programs, coordination is complex and requires directed effort. Panel members said that NWFSC and the SWFSC need to continue, expand, and institutionalize coordination between centers and among scientists working on groundfish data and assessments, including the designation of an individual with the responsibility to reach out to internal and external partners and to lead science within the survey program

- **Data Management and Access.** With almost all of the fishery independent and dependent programs described for this review, issues relating to data processing, management and access were readily apparent. An informatics system is needed and expressed reliance on platform specific or proprietary software belies appreciation of the breadth and complexity of the problem. The information management needs for this program are foundational and critical and a recurring theme among Panel members. Panel members said that these needs should be addressed in a comprehensive fashion for survey, commercial and recreational, and observer data. It appears there is a plan to address much of this need that Panel members said should be energetically pursued since it impacts the ultimate utility of the data for both short term (in-season management) and long-term uses of these valuable data.
- **Data application within assessments.** Panel members said it was difficult to near impossible to ascertain which data being collected were most critical to stock assessments and had the largest influence given the assessment summary documents provided. The data matrix provided qualitative scores but failed to provide quantitative evidence of how changes in data quality, statistical precision, or timeliness will affect the stock assessment output in terms of accuracy, precision, or timeliness.
- **Off-year cycle for assessments.** That data are focused on a biennial cycle for conducting assessments is appropriate given the relative newness of the programs and given staff limitations. Nonetheless, Panel members said that it should be a goal of the Center to implement a policy of ongoing assessments to perhaps better integrate research with assessments. This strategy may also improve the timeliness of how data are applied for fisheries management. Constraints due to the STAR panel process should be re-evaluated, particularly in light of the newly developed categories of assessments (i.e., updates, data moderate, data poor).
- **Survey implementation.** The Panel members recommend that the Center initiate a plan to revisit its survey design. For example, Panel members could not find adequate documentation of the statistical design used in identifying sample locations for the bottom trawl survey. There is a recommendation to have a programmatic review of the sampling design with a product being a complete variance model, and evaluation of prioritization of sampling for within-year status vs. long-range trend, and an evaluation of the design consequences for alternatives. A monitoring and science coordinator/team leader should have equal standing within the leadership of the survey teams.

- **Bottom Trawl Survey.** Continuation of the NWFSC annual bottom trawl survey is critical. Even with issues of untrawlable habitat and coverage, it supports more assessments than any other fishery independent source of data on the West Coast. The current bottom trawl survey is carried out using rigorous protocols, and the very latest in technology, enabling them to be carried out effectively by a relatively small staff, and very low survey vessel costs. Questions and uncertainty of funding to support surveys make it important that the NWFSC begin to look at impacts on their stock assessments of reduced survey sampling density and survey frequency. It is recommended (as with the acoustic trawl survey discussed below) that the NWFSC and SWFSC look at ways to jointly address issues of survey sample design, frequency, and impacts of untrawlable habitat.
 - The Panel members said that the utility of the annual west coast bottom trawl survey is strongly impacted by the large percentage (40%) of the survey area that is not suitable to be sampled by trawls. Efforts should continue and be expanded to more fully map and identify the untrawlable habitat. Panel members recommend collaboration with other regions and agencies to develop sampling technology and protocols for untrawlable habitat, using advanced technology within NMFS as well as reaching out to other research centers such as the USGS' Innovation Center in Menlo Park, and NASA-AMES. Panel members suggest multi-modal approaches that leverage ROV/AUV, camera, acoustics technology for abundance and commercial/recreational observer for sample collection at the same sites.
 - Some decisions to alter bottom trawl survey gear have been made without a thorough analysis of their impact on the historical time series. Calibration is a major impediment but potentially resolvable with the appropriate allocation of resources.
 - NMFS should be encouraged to look at this issue from a national perspective. Are there alternative ways to secure support from industry or use of the sale of research quota that can be used to cover costs of charter ship time.
- **Hake Acoustic Survey.** The acoustic-midwater trawls survey provide data that is critical to the hake assessment, and is carried out with state-of-the art protocols and survey technology. Coordination and inter-calibration of data from joint Canadian surveys always complicates the task, but is necessary if the combined survey is to cover the complete geographic range of the hake stock.

- Vessel effects are well documented in acoustic surveys, and corrections are difficult. There is a general concern that the time series over different vessels may be difficult to compare. The Panel members recommend that one of the acoustically-quiet NOAA vessels that were designed and built to overcome such a problem should be permanently allocated to carry out all hake survey work.
 - The Panel members also recommend that acoustic survey data collected during 1977-1992 now little used in assessments, be properly archived and maintained for potential future use.
- **Hook and Line Survey.** The hook and line survey seems to be an innovative approach to provide data from areas that cannot be sampled with trawl gear. Panel members noted that questions raised by CIE reviewers regarding hook saturation and design still need to be fully examined. The survey has proven useful in providing indices of abundance for several species, and has the added benefit of promoting interactions between scientists and stakeholders. Panel Members said that similar CPUE indices could be extracted through a statistical analysis of opportunistic data being collected aboard commercial passenger carrying fishing vessels. This is a fairly low cost survey and might be worth expanding within that area and similar areas along the coast.
 - **Cowcod Visual survey.** The visual surveys using submersibles was an exciting application to estimate the abundance of otherwise hard to sample species. Panel members said that this survey has contributed to the cowcod rockfish assessment in a significant way since it provides an absolute biomass estimate. The promise of visual surveys (manned or unmanned) to help in untrawlable grounds was demonstrated and this work is an important contribution towards improving the utility and application of traditional survey methods and provides an excellent example of how NMFS should pursue and evaluate the use of advanced technologies to support stock assessment.

- **Juvenile Rockfish Survey.** The Juvenile Rockfish Surveys have provided valuable information on the abundance, distribution, and early life history of rockfish and hake on the effects of physical and biological factors on rockfish recruitment. Published work from this survey has demonstrated support for the hypothesis that environmental factors play an important role in regulating recruitment. The geographic extent of these surveys has broadened over the years, providing increasingly comprehensive data on relative abundance, recruitment processes, and the California Current ecosystem. While data from these surveys have been of limited use in stock assessments to date, their ultimate contribution to such efforts might improve with broader, more consistent survey coverage. This program is an impressive example of collaborative science in ecosystem studies. There is evidence of collaboration across assessments and research inside as well as outside the agency, leveraging high-value monitoring program to support partnerships. There is a temptation is to recommend that other programs adopt this model of closer integration between the science/research enterprise and the sampling enterprise. There is a recommendation that a workshop should be held to evaluate how these data can best be used in assessments and examine the value of expanding this type of survey. Such a workshop could also be used to evaluate other innovative indices such as the impingement index.
- **Biological Sampling and analyses.** There is a great ability to collect biological (and environmental) data through the combined efforts of NMFS surveys, observer program, and State commercial and recreational data collection programs. Panel members said that collecting otoliths and other samples create costs in terms of archive and storage, but benefits for special future projects could prove invaluable. Such opportunistic sampling can be critical for ecosystem and finer-scale studies and may be important for second order application to stock assessment. Sampling programs should consider data that can improve understanding of stock structure and fish movement. For example, genetics, tagging, tracking, and other methods (e.g., eDNA) may provide insight on various scales useful for management. As with the other programs, the importance of appropriate sampling design and evaluation of required sample levels is something that is needed. For example, Panel members said that otolith sample sizes used to estimate age composition often seem low so that a more rigorous analysis of the effect of numbers of ages on the assessment outcomes should be conducted to better manage this process. It is also possible to use the observer program and possibly State sampling could be used to address improved maturity and food habits data. The NWFSC should again be encouraged to identify and prioritize needed data collections to support their stock assessments.

- **West Coast Groundfish Observer Program:** Reliable catch and discard mortality data are critical components in any stock assessment. The Observer Program that has been implemented for West Coast federal groundfish fisheries has greatly improved the quality of these data. The NWFSC has done an excellent job in the oversight and management of this program. Data from the Program is available in a timely way for in-season catch management but there are issues associated with the combining of PacFin catch and observer data on discards at the end of the year that prevents the second year of catch data from being used in the biennial stock assessment cycle. This situation as with other data management issues experienced by the other data collection programs needs to be addressed.

Data were presented that indicated that the level of discards in these fisheries has been decreasing potentially resulting in loss of the spatial and temporal data provided by observers on catch, effort, and biological data. The NWFSC should begin looking ahead to what will be done if continuing decreases in discards degrades these data and what options will be available to obtain this information via either reduced required levels of observer coverage or expanded sampling of the retained catch at sea before delivered shoreside. It is recommended that NWFSC initiate cost-share agreements to supplement the non-hake and non-catch share observer program budget.

Panel members said that there is a need to bring the structure and design of RecFin up to date. Panel members encourage the continued cooperation, exchange of information on best practices and standardization of data collected and methods to the greatest extent possible across the three states. The PSMFC provides the forum to do that.

- **Forward Compatibility/New Technologies.** Panel members said that current data requirements and shortfalls may be a poor predictor of future data requirements. In 20 years, what data will the Center wish it had been collecting? An exclusive focus on the needs of the current assessments may jeopardize future capabilities. Panel members said that if the long-term trend is toward more multispecies and ecosystem-based management, then the Center will likely want to enhance its collection of data that will help scientists understand how species interact (e.g., stomach contents, habitat preferences, spatial distribution, etc.). As with other programs, it's difficult to know how much is enough and what trade-offs exist for different data collection programs until a larger scale programmatic evaluation takes place. This should include an evaluation of the relative economy of collecting (and archiving) inexpensive data that may be presently of uncertain utility.

Relative to climate change, what data will allow the Center to anticipate or respond to the changes in the temporal and spatial patterns of fish as well as how ecosystem connections may be altered? There are no clear answers, but

it is important for the Center to be thinking of such issues when prioritizing data collection programs.

It is important that NWFSC scientists continue to explore stock structure using the latest genetic methodologies and analyses, as it is likely that assessments will have to be made on smaller spatial scales for many species of rockfish. Estimates of mean larval dispersion distance obtained using genetic data continue to reveal that stock structuring is often poorly understood for these species and can occur on much smaller geographic scales than is currently appreciated.

A large array of new technologies were presented and discussed during the review and the use of emerging technologies is important to both improve the science supporting our data collections and identify potentially more cost effective means of providing the data needed for stock assessments. Perhaps the closest technological development that could improve data quality was with the use of cameras. Broader national and international efforts are occurring and applying these to stock assessments should be encouraged. There are opportunities to investigate the utility of ROV, AUV, optical methods, remote sensors and manned submersibles. There needs to be a clear plan to move this program from small experiments to a more operational program.

III. Issues Raised by Members of the Public. There were no issues raised by the public during this review.

IV. Concluding Comments. Groundfish monitoring is a large and complex enterprise. The staff has done heroic work with limited manpower to implement a program that is truly impressive. They have demonstrated high expertise and effort and deserve tremendous credit. With questions and uncertainty of funding to support surveys, the NWFSC should begin to look at impacts of reduced sampling density. There is a general need to statistically evaluate survey design and sample collections, especially as funding for these activities becomes more limited. Analyses are needed to make informed decisions on what can and cannot be modified and to identify impacts on stock assessments for your constituents as changes are proposed and made. As stated above, almost all of the data collection programs reviewed this week identified issues with management and dissemination of data. This weakness needs to be addressed in a comprehensive fashion for all areas of these programs. The NMFSC should continue to maintain and archive reliable time series for catch (including bycatch), age composition, and survey data. These time series are critical for reliable stock assessments. The Center should maintain its commitment to process studies that go beyond the demands of annual stock assessments. A key goal of the assessment enterprise should be a clearer understanding of the processes that determine recruitment. Efforts have clearly advanced farther along some lines (e.g. specific sample collection) than on other lines (monitoring science & data management). A more structural approach to

monitoring science is recommended with the intent to shore up some of the less advanced components of the groundfish monitoring program.

Northwest Fisheries Science Center Science Data Collection Program Review

Reviewer 1

General Observations

Assessments for west coast groundfish require cooperation between the Northwest Fisheries Science Center, Southwest Fisheries Science Center, Pacific States Marine Fisheries Commission, Environment Canada, and the states of Washington, Oregon, and California. Interagency cooperation appears to be good, although each of these agencies is being asked to do increasingly more with ever-decreasing personnel and budgets. Without continued mission-oriented perspectives and support by each agency contributing to the assessment enterprise, it is difficult to see how the productivity of west coast groundfish resources can be properly managed and sustained. Several groundfish stocks (mostly rockfish) have already been depleted, and some have been listed under the Endangered Species Act. This situation has forced the industry to forego catches from otherwise healthy stocks in order to facilitate the rebuilding process for those that have been depleted. The economic welfare of the west coast groundfish industry will be negatively impacted if the agencies involved in the assessment enterprise aren't supported with the resources required to address their mandates.

The presentations made during the review provided an excellent overview of the activities conducted within each program unit (at both the Northwest and Southwest Fisheries Science Centers) contributing data to the assessment process for west coast groundfish. Nevertheless, it was usually difficult to tease out which of the data being collected were most critical to stock assessments. As a result most of my comments pertain to individual data streams (e.g. catch, survey or age composition), without a more holistic appraisal of their relative impact on the accuracy of the resulting stock assessments.

- **Fishery Independent Data**

-

- Bottom Trawl Survey

- The NWFSC bottom trawl surveys employ rigorous protocols, and the very latest in technology, enabling them to be carried out effectively by a relatively small staff, with low survey vessel costs. Nevertheless, some decisions to alter bottom trawl survey gear have been made without a thorough analysis of their impact on the historical time series. The current (Aberdeen) survey trawl was designed for a continental slope survey (183-1280 m) in 1998, and then used on the shelf beginning in 2003, replacing the (high-opening/hard-bottom) Noreastern trawl that had been used on the shelf and upper slope (55-500 m) during 1977-2002. There were apparently good logistical reasons for this change, but only limited intercalibration of the two trawls was ever carried out. This has resulted in two distinct time series of trawl survey abundance on the shelf that don't overlap in time.

When the NEFSC trawl was redesigned to replace the original "Yankee" trawl, multiple side-by-side comparisons were conducted with the original gear to obtain calibration coefficients by species. Calibration coefficients could also be obtained by surveying the shelf with both the Noreastern and Aberdeen trawls in some years, designing the joint survey in such a way that intercalibration coefficients can be estimated statistically from the data (e.g. Kappenman 1992).

Since the 1977-2002 surveys with the Noreastern trawl were conducted only once every three years, and the current Aberdeen surveys are conducted annually, the time series for the shelf could also be recovered by surveying the shelf with Aberdeen or Noreastern trawls on alternate years. This could be continued until acceptable intercalibration coefficients are obtained.

- Hake Acoustic Survey
- The acoustic-midwater trawl surveys provide data that is critical to the hake assessment, and are carried out with state-of-the-art protocols and survey technology. Coordination and intercalibration of data from joint Canadian surveys complicates these surveys, but are necessary if the combined survey is to cover the complete geographic range of the hake stock.
- Vessel effects are well documented in acoustic surveys, and it is difficult to correct for them. The current practice of using different vessels, often in an ad hoc manner, to conduct the hake surveys has probably compromised the time series. Acoustically-quiet NOAA vessels were designed and built to overcome such a problem, and one of these should be permanently allocated to carry out all hake survey work.
-
- Acoustic survey data collected during 1977-1992 have been deemed to be of little use in recent assessments, apparently because of shortcomings in technology and survey design. As a result, maintenance of the archives for these data has lapsed and they are in danger of being lost. In the future, scientists using different analytical techniques or with different scientific objectives might well find these data to be useful, and every attempt should be made to rescue and archive them.

Hook and Line Survey

This survey is carried out in southern California by volunteer anglers using standardized protocols and statistically designed survey grids to obtain CPUE indices for nearshore species. The cost of these surveys is relatively low, and they have the added benefit of promoting interactions between scientists and stakeholders. Nevertheless, it appears that similar CPUE indices can be extracted through a statistical analysis of opportunistic data being collected aboard Commercial Passenger Carrying Fishing Vessels. An analysis of the relative merits and costs of alternative methods of obtaining the CPUE indices required for assessments should be carried out.

Pelagic Trawl Survey for Juveniles

These surveys began in 1983, and have provided valuable information on the abundance, distribution, and early life history of rockfish and hake. The geographic extent of these surveys has broadened over the years, providing increasingly comprehensive data on relative abundance, recruitment processes, and the California Current ecosystem. While data from these surveys have been of limited use in stock assessments to date, their ultimate contribution to such efforts might improve with broader, more consistent survey coverage.

Fishery Dependent Data

Reliable catch and discard mortality data are critical components in any stock assessment. The NWFSC personnel and their colleagues at PMFC and state agencies have made tremendous strides in improving the quality of these data over the last few years. Their rapid response to the challenge of implementing the observer program and data analysis infrastructure required for 100% coverage of the ITQ fishery is particularly impressive. Nevertheless, all agencies involved continue to struggle with the challenges of obtaining reliable catch and discard data from recreational and small-boat commercial fisheries. Continued cooperation and support of all agencies involved in collecting and improving these data should be encouraged.

Biological Sampling

Age determination work carried out by the NWFSC employs rigorous protocols and state-of-the-art techniques for validation. Nevertheless, otolith sample sizes used to estimate age composition often seem low. The danger of biased spatial representation and low precision are well recognized by NWFSC scientists, and they collect many more otoliths than are actually read. The Center has archived many of these otoliths in the event that it becomes necessary to read them in the future.

Retrospective analyses of statistical power and assessment model sensitivity associated with different otolith sample sizes should be carried out to determine if current sample sizes are providing acceptable results.

Emerging Technologies

Scientists at the NWFSC are actively engaged with the larger fisheries and oceanographic community in exploring emerging technologies. They are proactive in implementing such technologies (e.g. in-trawl cameras for acoustic surveys, bomb carbon validation of ages) and should be commended for this.

It is important that NWFSC scientists continue to explore stock structure using the latest genetic methodologies and analyses, as it is likely that assessments will have to be made on smaller spatial scales for many species of rockfish. Estimates of mean larval dispersion distance obtained using genetic data continue to reveal that stock structuring is often poorly understood for these species and can occur on much smaller geographic scales than is currently appreciated.

NWAFSC survey and assessment scientists recognize the importance of mapping and surveying habitat that can't be sampled with trawls. Nevertheless, some of the habitat under their jurisdiction has yet to be mapped using multibeam acoustics, and this deficiency should be remedied as soon as possible. Scientists at both the Northwest and Southwest Fisheries Science Centers are active in the development of ROV, AUV, acoustic and optical systems capable of quantifying the abundance of species

that inhabit untrawlable bottom and should be encouraged to continue these efforts

Key Recommendations

1) Continue to maintain and archive reliable time series for catch (including bycatch), age composition, and survey data. These time series are critical for reliable stock assessments.

2) Maintain a commitment to process studies that go beyond the demands of annual stock assessments.

Most stock assessments and forecasts assume that recruitment is strongly dependent on spawner biomass, although it is sometimes clear that this isn't the case (e.g. attached Figure from 2012 Hake assessment). Nevertheless, forecasts and rebuilding plans require quantitative predictions of annual recruitment decades into the future.

A key goal of the assessment enterprise should be a clearer understanding of the processes that determine recruitment. These processes are often identified through retrospective analyses, comparing time series on recruitment with corresponding time series for environmental parameters (temperature, upwelling indices etc.), and indices of the abundance of key predators and prey. This research requires a long-term (multi-decadal) commitment to the collection and archiving of the data required for such analyses.

Northwest Fisheries Science Center Science Data Collection Program Review

Reviewer 2

I. General Observations

The NWFSC scientists, with significant contributions from their colleagues at the SWFSC, collect stock assessment data efficiently and of high quality. Relative to other fisheries situations in other parts of the world, their program on balance is well above average. The NWFSC are to be commended for this given the complexity of the situation and their limited available resources. The reference figure used throughout the week is provided below in Box 1.

In general, the relationship of current and planned fishery assessment data activities to support fisheries stock assessments is on the right track. The NWFSC staff are using the best available techniques and approaches for modern stock assessments. However, some opportunities should be pursued to improve the infrastructure for the database systems and enhance collaboration with neighboring science centers and other research institutions.

Most aspects of the survey design, standardization, integrity, and peer review is excellent and the Centers' effort to improve on all aspects was clearly demonstrated. Regarding overall quality and timeliness of the data, the biennial schedule for assessments means data are applied to stock assessments and fisheries management in a way that could be improved. It is understandable given the newness of the program that having an off-year period to help work on preparing data would be beneficial. There may also be a constraint related to the STAR panel process that impedes conducting assessments on an annual cycle.

The extent that the statistical precision (as related to data within assessments) could be improved upon given existing resources was difficult to judge but in general seemed adequate and on par with similar endeavors elsewhere.

The fishery data systems (i.e., database platforms, collection systems, dissemination programs) seem poorly organized and in need of an overhaul. There appears to be little cross fertilization between programs. Nonetheless, these shortcomings are well understood and the FRAM group is pursuing very innovative approaches towards addressing these shortcomings.

Overall, limitations and weaknesses seem to be mostly related to available resources. Areas where things can be improved given current staffing include more

study on survey planning, assessment priority, and leveraging existing and developing technologies.

General recommendations are as follows:

- Provide better methods to streamline survey data processing so that it can be made available earlier (prior to the assessment; improving timeliness)
- Maintain and further develop assessment “categories” to help prioritize data collection and assessments—should continue to involve the PPMC
- Consider moving toward an annual cycle for assessments but select stocks based on their priority and dynamics (e.g., a long-lived species may not require assessments as frequently as a species such as Pacific hake)
- Prioritize data collection programs and consider the cost of obtaining the data versus their likely benefit in applied fishery assessments
-

II. Key Findings and Recommendations

a. Fishery Independent data

Several types of fishery independent data are collected in support of the stock assessment enterprise. Some are more directly related than others and the spectrum extends (it seems) from FRAM’s bottom trawl survey which is most closely directed to stock assessments to process-type studies (e.g., CALCOFI) that have a lower direct impact on assessments.

For the bottom trawl survey, due to budget constraints, survey station density decreased in 2013 (only 3 boats were available to conduct the survey instead of the usual 4). To judge the impact of this reduction it would have been useful to evaluate how the survey CV changed for selected species. Even had that been done (to evaluate data precision) given the presentations it would be difficult to speculate on the impact it would have had on a particular assessment.

One suggestion would be to evaluate how effort could be more economically reallocated to reduce CVs of priority species. Also, alternatives where vessel assignments to stations are modified so that sufficient overlap occurs (for vessel-effect variation to be considered) but shorter run-time distances between stations. The development of methods to best use the raw survey observations (using specially developed GLMs) seemed appropriate and should be continued.

It should be noted that reducing uncertainty in abundance indices is only one measure of the utility of surveys for assessments and fisheries management. Other practical benefits of surveys (in particular from chartered boats) arise due to increased interaction with (and added trust of) stakeholders. Scientists’ interactions with fishermen can prove useful for considering conditions on the grounds and provide feedback on where more study is needed.

Regarding how survey personnel are incorporated into the stock assessment enterprise, it was encouraging that FRAM leadership was making efforts build relationships among scientists that are directly and indirectly involved. This seemed to be an excellent strategy, particular for new hires and early career staff.

The bottom trawl operational approach for data entry and management was tied to FISCUS which had some likely benefits getting the program underway but resources are lacking to upgrade the system and in the medium to long term there could be some compatibility issues. Presumably some infrastructure from other centers (e.g., the AFSC) for supporting very similar surveys could be leveraged.

Data dissemination apparently consumes a fair amount of staff time outside that normally used for stock assessment purposes (e.g., for external research projects at universities). It may be helpful to have an entity like PACFIN assist with post-survey data handling for standard dissemination purposes.

The acoustic survey for hake is a large undertaking and involves NOAA ship time. There is a general concern that the time series over different vessels may be difficult to compare (some earlier data are presently omitted from the assessment). In particular, some data from earlier surveys may be lost if maintenance of the archives lapses. Measures should be made to avoid this situation.

The acoustic survey group provided a detailed summary of the data processing and on-board sampling protocols including the frequencies used by their sounding equipment and the development of trawl net cameras to help identify species within different swaths of echosign. A story that was left untold had to do with the “emergency” 2012 survey which was partially funded by industry involvement.¹ This was an interesting example because it demonstrated the importance of 1) conducting regular surveys, 2) involving industry in research activities; and 3) FRAM Division scientists’ ability to adapt to situations as needed.

Another aspect of this (2012) so-called SaKe survey (sardine and hake) was that some process-study data collections were dropped. The contribution and importance of this survey to the sardine assessment is outside the terms of reference for this review so this trade-off is difficult to judge. Also, while the presentations were excellent and proved that the work was of high caliber, the importance of the 2012 survey on the assessment and fisheries management of hake was not discussed (presumably it had a big impact since the 2011 estimate was nearly 3 times lower than that of 2012).

¹ This is from memory, the reviewer was unable to ascertain the extent that the industry ended up contributing to this survey effort in 2012.

A major issue with the utility of the acoustic survey is the potential that the Canadian component will be discontinued. This would affect the assessment. Contingencies should be discussed and planned should this occur.

The hook and line survey seems to be an innovative approach and one that has received extensive review with constructive directions on how it might be improved. It seems unfortunate that the survey excludes the cowcod conservation area. It seems to be relatively inexpensive but again, the ability to judge the role the index plays in, say, the bocaccio assessment was difficult to evaluate.

The juvenile rockfish survey represents a valuable time series and has a number of relevant applications for assessments. This survey provides a reliable index of pre-recruits for rockfish. Since this time series is among the longest on the west coast it is valuable for understanding the impacts of climate variability and ecosystem structure. Published work from this survey has demonstrated support for the hypothesis that environmental factors play an important role in regulating recruitment—an issue that is central to management where population spawning biomass levels are set to avoid recruitment overfishing.

The visual surveys using submersibles was an exciting application to estimate the abundance of otherwise hard to sample species. This has contributed to the cowcod rockfish assessment in a significant way since it provides an absolute biomass estimate. The promise of visual surveys (manned or unmanned) to help in untrawlable grounds was demonstrated and this work is an important contribution towards improving the utility and application of traditional survey methods.

b. Fishery Dependent

Within NOAA, the observer program is the largest component of fishery dependent data used in stock assessments. The program at the NWFSC began with a sound statistical design for assigning coverage to a complex and geographically dispersed fleet. With the advent of the catch-shares program, the work has evolved and improved over its short history. The safety standards, data quality, training, and staff experience are all on the mark and commendable. For the work, the number of FTEs (11) seems quite low but the PSMFC apparently supplies additional support to run the program.

Outside of NOAA, Oregon, Washington, California, and PSMFC are the key partners that provide vital information for stock assessment purposes. The diversity of commercial fish ticket data between states requires extra effort for assessment scientists. The philosophy of FRAM's leadership on this issue was to ensure that the Federal scientists work close with state biologists and port samplers to best understand the data they use. Establishing and maintaining these relationships is extremely important and should remain an important part of assessment scientists' activities.

Methods for total catch estimation to species often involves some form of extrapolation to unsampled hauls or offloads (so called “borrowing”). The approaches for doing this varied between different agencies with some using annual averages within a region and others using a shorter period averaged over a broader region. Another method mentioned involved using a Bayesian estimator. Whereas the methods used may differ appropriately given fishery differences, understanding these data processing steps should be a priority for assessment scientists. Where appropriate, they should be modified to reduce the potential for biases and overall uncertainty.

Apparently poorly sampled stocks, e.g., those in the live-fish fishery represent a particularly difficult problem for Federal observer sampling programs. Since these are most typically near-shore species, state agencies should be given a larger role on monitoring the status of these stocks.

c. Biological Sampling

The overall level of sampling appears to be adequate for stock assessment purposes. The fact that for some species the number of otoliths exceed the number that are being used for assessment purposes was unlikely to be an inefficient use of at-sea staff tasks. However it was hard to judge from the materials presented and it may change over time (i.e., some species may become more critical than others). It was clear that collecting otoliths and other samples create costs in terms of archive and storage, but benefits for special future projects could prove invaluable. Such opportunistic sampling can be critical for ecosystem and finer-scale studies which may be important for baseline studies.

For both the survey and observer programs there is a need to connect the purpose of sampling in the assessment process so that those doing the difficult data collection tasks can maintain motivation to provide high quality information.

Data collected for process studies tend to have a second order application for stock assessment purposes. In particular, food habits data, ichthyoplankton sampling, environmental indices, and habitat characteristics. Of these, habitat characteristics may help with delineating untrawlable grounds and defining strata for various species considerations. Food habits information should be considered important as resources become available to collect and process such information since patterns in trophic relationships among species are important for ecosystem considerations. Such data can also provide insight on patterns in natural mortality that have direct application within stock assessments (e.g., accounting for increased predation during periods of high jumbo squid abundances for hake).

d. Emerging Technologies

A large array of new technologies were presented and discussed during the review. While obviously few if any are directly used in stock assessment, most of them had clear pathways towards eventually providing useful information. Perhaps the closest technological development that could improve data quality was with the use

of cameras. Development along these lines seems most fruitful for stock assessment purposes.

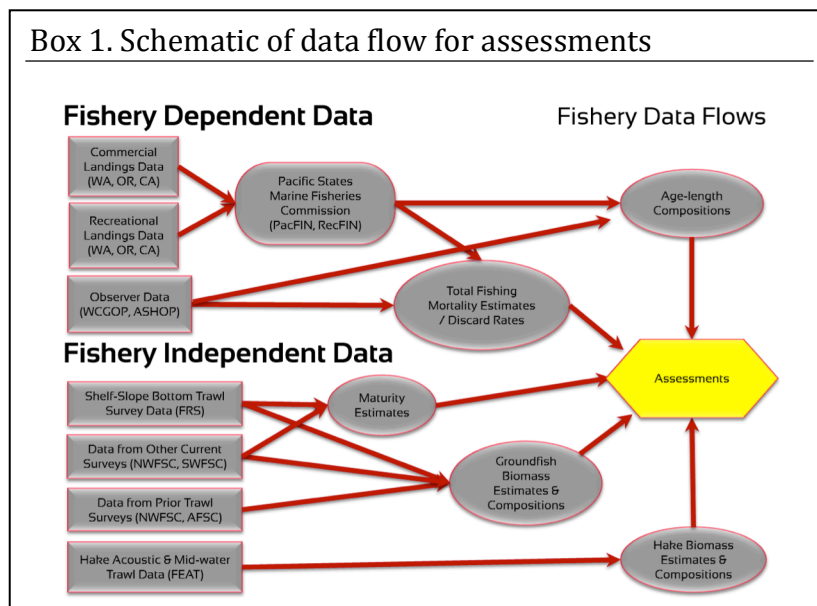
e. Data Management

As is presented in the summary report, the NWFSC and NMFS would benefit by developing a comprehensive information system. It seems that the fishery independent and dependent programs have serious issues relating to data processing, management and access. Basic support (in the form of database maintenance and access) is needed for survey, commercial and recreational, and observer data. The appeal to outside funding sources (i.e., as noted in video on the utility of a comprehensive approach—the “aspirational data management project”) is encouraging. The list presented in the summary report is sensible and one that should be considered in developing the program (reproduced here for completeness):

- I. Ongoing Design collaboration with users
- II. Database design
- III. MetaData Catalogs
- IV. Business Rules
- V. Curation/Husbandry/archive
- VI. Query Design
- VII. Cyberinfrastructure
- VIII. Documentation
- IX. Training

Additionally, specific efforts on the data collection side could be enhanced with respect to FRAM assessment scientists. Namely that some datasets from state and other agencies appear to be underutilized. For example, some fisheries have a relatively long time series of logbook information which may be useful for understanding effort patterns and minimally, as a cross check for models which may imply large changes in the fishing mortality (reflecting effective effort) during recent periods.

Box 1. Schematic of data flow for assessments



Northwest Fisheries Science Center Science Data Collection Program Review

Reviewer 3

I. General Observations

These are large-scale surveys – that means significant logistical challenge. This requires comprehensive, modern, professional commitments to properly resource these projects. The belief that “best-available” provides the discretion to make ad hoc decisions on levels of effort, or “just make do” is not good enough for a monitoring enterprise that is this important and had this big a financial and cultural footprint.

On the one hand, it is clear that a small labor pool is faced with this large task, and through hard work, extraordinary effort and significant creativity are accomplishing a level of monitoring that is truly impressive in the context of effectiveness in the face of limitation.

On the other hand, there are serialized comments by staff that “we only have so much manpower/money/ship days, so we didn’t resolve X, Y or Z”. This is hard to accept. Whether you are willing to admit it or not, regardless of the rhetoric to the contrary, it is a de facto statement on how important X, Y or Z is to your enterprise or agency. If some components of the survey are investigated, but others are not, it doesn’t matter if it is a decision based on resource limitation or expertise limitation, it still defines that the agency thinks is important.

What does seem systematic is that staff are documenting some things really well, but other things not as much. As a consequence, there is the inference that effort is being extended deeply in some areas and not in others. This indicates that in spite of the herculean effort on the part of staff overall, there are areas where effort needs to be reallocated from some things to others. Examples include evaluations of relative sources of variance in the data and data management. Further, this is a feature not of one program vs. another – e.g. hake survey vs. hook and line survey, but rather it is a feature of the components of all the surveys.

II. Key Findings and Recommendations

a. Fishery Independent

Components of each of the following points cross over from fishery independent activities to the others, and so perhaps are more correctly General Observations, but they seem somewhat specific and so I left them here.

1) Among the Bottom trawl survey, the Hake survey, the Hook and line and the Visual surveys, there is evidence of a huge effort in “response design”, but little evidence of a parallel effort in “sampling design”. Sampling design is where to measure and when to measure; response design is how you measure once you get there and how that data gets used.

For example, there is almost no documentation of the statistical design used in identifying sample locations for the bottom trawl survey. Supplemental documents were supplied (Strata_Tow percentages for NWFSC Bottom Trawl surveys, Primary and Alternative Station Selection for the FRAM ..., Strata Tow percentages for NWFSC...). However, these documents either simply state that strata were established without methodological approach (“It was decided at a meeting of the FRAMD stock assessors and Rick Methot that the new breakdown for the survey should be to split the number of tows at 80% north of Point Conception (34.5 degrees north latitude) and 20% south of Point Conception.”), or it describes the analysis – in terms of an R program subroutine that is invisible to the reader (“The core function of the delta-GLMM estimation is named fitCPUModel. This function is sourced automatically via the file “fitCPUModelvX.X”. Arguments for the function and their default options are as follows...”).

What one really wants to see is a variance model for the design of the station selection. A variance model is an expression of how the relative variances contributed by component sources of variance in a survey contribute to the overall variance of the estimate or index. Is the variance expressed in each measurement bigger or smaller than the variance across samples for instance? For example, one variance model used by the EPA in Clean Water Act monitoring for estimating slope or trend with a stratified random sampling with multiple visits to sites per year is:

$$\text{var}(slope) = \frac{\frac{S_s^2}{N_s} + S_y^2 + \frac{S_i^2 + \frac{S_v^2}{N_v}}{N_s}}{\sum (y_i - \bar{y})^2}$$

Where the subscripts on N are: v = number of visits per season, s = number of sites, y = number of years; the additional subscripts on the variance, i = an interaction term between space and time and t = total. This is an example, it is likely not the answer for this particular implementation. Most of the time the variance model is not nearly this complicated, but the point is there is an explicit connection between various sources of uncertainty and the allocation of sampling effort.

The reason we want to see this is clear, because the interaction between variance and sample number or revisit number is a way to evaluate the optimization of strata identification and allocation of resources to the sampling design. This is the way one addresses the question of more samples vs. more care at each sample point vs. less frequent sampling (e.g. every other year vs. every year). Experience is that total statistical performance per unit dollar is improved with more samples far more than reducing the variance in any given sample, and one sees this results from

a small effect of changes in S_v^2 from improving the sample collection, Data QA/QC etc. vs. large improvements that result from increasing N_s .

So how is the panel to recommend changes in the sampling program without an ability to evaluate how this program made its decision?

One recommendation is to have a programmatic review of the sampling design with a product being a complete variance model, and evaluation of prioritization of sampling for within-year status vs. long range trend, and an evaluation of the design consequences for alternatives. All of the requisite data already exists in the current survey programs. Are we spending too much time and/or money on making sure every data point is perfect and too little time on increasing sample size? Based on the covariance structure in the data collected, which is an expression of the interaction between the sampling design and the spatial structure of variance in the sampled population, what is the smallest area that the sampling universe can be sub-setted and still produce a reasonable answer?

2) The issue of a monitoring science deficit within the program (point 2 above) was highlighted in two additional instances that point to a more general need.

In discussing the combo survey staff expressed a particularly deep frustration with the loss of potential sample sites due to allocation of space to State and Federal MPA's. This was problematic for staff in spite of the loss of area being a very small fraction of the total sampling universe, and indeed a tiny fraction of the otherwise untrawlable habitat within the sampling universe (see specific recommendation below). The key seeming to be that the untrawlable habitat was static, while the MPA's were forcing a change in the sampling program.

At the same time, staff revealed that 15 years of acoustic surveys for hake (1977-1992) are not compatible with current survey design and are no longer being used in assessments. The key to this loss being a lack of intercalibration data to allow continuity across surveys.

Assuming for the moment that these issues represent more than programmatic chauvinism, they point to a technical inability to accommodate change. It would be convenient if monitoring programs did not have to change; data collection and management protocols could be stabilized and products produced quickly and familiarly. But this is not common experience; things change and this program needs to be prepared for it better than it appears to be. In the context of diminishing budgets and clear indications that funding environments are going to get worse before they get better, this will demand yet more change than we have seen. It is unconscionable and unacceptable from a public service point of view that surveys that cost so much public money are not being used due to a technical incompatibility that was not foreseen and yet foreseeable. Examples of monitoring programs that have successfully experienced change do exist. One example is the CalCOFI program which started as monthly, has switched to quarterly and has a number of eras where the survey design was forced to change – and yet this

program survived and continues to make contributions (see <http://www.calcofi.org/field-program/survey-coverage-since-1949.html>).

I recommend that the program invest in a monitoring science coordinator. This staff position should be a quantitative, statistical science expert whose position operates within the leadership of the groundfish survey teams. The position should be resourced appropriately and authorized to access the data from surveys, assess survey designs and make design change recommendations to the FRAM director.

3) There is no informatics system and it is unclear that the need for this and the diversity of this need is appreciated by the managers of these programs. When queried, managers and staff have responded by saying that they are linked to specific platforms (MS Windows 8 etc.) or software (Access, Excell, etc.) for data management. The fact that staff are linking the issues to specific software solutions is a “tell” that the breadth of the problem is not appreciated.

The information management needs for this program are foundational and critical. This program is too complicated, too expensive, and too important to be rolling along with no informatics plan. Experience suggests that the vast majority of similar program reviews will have some similar statement on data management. Why then has the issue not been resolved already? There may be numerous reasons, but if the explanation is that we don’t know what adequate looks like, then we should eliminate that excuse.

In this case, an informatics plan is more than a database. An adequate plan would contain at least the following parts:

- Ongoing Design collaboration with users
 - What are the questions and how are they asked?
 - How do the needs evolve?
 - How to deal with new technology (e.g. Logs→VMS→AIS)
- Database design
 - Relationships between data elements
 - Data dictionary
 - Crosswalks
 - ERD
 - Semantics/Logic Models/Syntax
 - Foundational or “keystone” data elements.
- MetaData Catalogs
 - What are the regulatory requirements for metadata?
- Business Rules
 - Who adds data?
 - Who changes data?
 - When can data be added/changed?
 - When are backups done?
 - ...
- Curation/Husbandry
 - QA/QC techniques and queries

- Data Confederation (fusing data from disparate sources)
 - Update schedules
 - Backups
 - Pestering data contributors to deliver data
 - Workflow (linked to Data base design)
- Query Design
 - Links to science questions
 - Links to Data QA/QC
- Cyberinfrastructure
 - Server space
 - High-throughput porting
 - Electronic data collection on ship/dock/packer
 - User interfaces and automated queries
 - Web-services
- Documentation
 - Users Guides
 - Technical Manuals
 - Reporting requirements
- Training
 - Opening access to users
 - Lowers the bar for meeting metadata requirements
 - Increasing throughput of data to products and research

So far none of this is platform or software dependent. These needs can be met with a variety of platforms and softwares – including open source (e.g. PostGRES, Morpho, Kepler). And so far there is little of this structure demonstrated in the Bottom trawl, Hake, Hook and Line and Visual methods surveys. Importantly, some of this is simple housekeeping, but there are many places for research and information science--which is to say that there is significant design work to do – it's a science project, not an update license for Oracle.

Recommendation: these activities be addressed with appropriate and authorized staffing and resources to support FRAM data management issues. This enterprise needs to be recognized as integral to the survey enterprise, rather than a subordinate, technical service.

4) The expressed allocation of sampling in the Bottom Trawl survey is approximately 13,000 sample units, of which 1% are in State and Fed MPAs, 7% in Cowcod Conservation Areas, and 40% of the total are in “untrawlable” habitat. That suggests a prioritization – sampling in untrawlable habitat would address 40% of the under sampling problem. Even if the states doubled their MPA's every year (which is unlikely), it would take 25 years for this to match the area lost now to untrawlable habitat.

Therefore, my recommendation is work on the untrawlable habitat problem, and then the CCA problem, and leave the State and Fed processes for MPA's for last.

5) The juvenile fish sampling seems really impressive. Lots of evidence was presented for collaboration across assessments and research inside as well as outside the agency. Lots of evidence of leveraging high-value monitoring program to support partnerships. One is tempted to infer that the close link of the science side and the assessment side of the house on this project leads to a more forward looking approach to monitoring.

Recommend that other programs adopt this model of closer integration between the science/research enterprise and the sampling enterprise.

b. Fishery Dependent

1) 40% of the budget is allocated to the observer program. Yet, the observer program is the one survey component that is clearly serving the most multiple-duty for other regulatory and enforcement needs (quota services, etc.). It seems reasonable that this survey component is the place where the RO, OLE, the industry and the conservation NGO community should be performing cost sharing. It is recommended that NWFSC initiate cost-share agreements to supplement the observer program budget, allowing a subsidy to other program components.

2) Given that 40% of the budget is going to the observer program, it occurs that this is a program that needs to pull more science weight to support the other programs. \$4.3M is too much money not to do more service to the other programs – particularly if the program is subsidizing so much assessment-independent management. Opportunities to collect other data from these cruises should be exploited. There was some indication that this idea is already being implemented. This is good, but it should be made a high priority for this program and actively supported by FRAM division.

c. Biological Sampling

1) Staff presentations on Biological Sampling were inscrutable; on the one hand, there was a clear demonstration of utility for the stomach content and maturity studies performed as part of surveys, on the other hand, the work was described as “side-projects” performed in the interest of individual curiosity. If the data provided by this work is valuable, then do it. The projects seemed to be characterized as side-projects added onto the trawl surveys in order to rationalize their emergence and subsequent senescence and extinction. That is fine, but then they are not part of the program per se, and don’t hype them as important programs.

I recommend making them institutional parts of the trawl survey and observer programs in the same way that the otolith work is supported. There appears to be a clear demonstration on the part of the Juvenile Fish monitoring that collaboration between the survey and the science teams has improved the products from both – and biological data is one example. But before tactical recommendations are relevant, the NWFSC & FRAM need to decide the more strategic issue of if the biological data are components of the assessments.

d. Emerging Technologies

1) There are a number of impressive examples of demonstration projects and experiments with emerging technology. It is clear that FRAM staff have been on the advancing edge of new technology for a long time. There are clear opportunities to extend these successes in ROV, AUV, optical methods, remote sensors and manned submersibles.

That having been said, it is not clear if there is enough leadership in technology deployment in this field. There needs to be a clear plan to move this program from small experiments to a more operational program. Currently, there is only one project across the entire west coast of N. America that is using manned submarines – and the Delta is 15 years old. What are the plans to operationalize advanced technology across a broader range of programs? I recommend performing and dissemination an Agency-level review of emerging tech that addresses questions of programmatic management: How are future budget scenarios going to allow this technology to be deployed? And to what extent does operationalizing emerging technologies save or cost money relative to simply grinding it out with traditional technologies?

e. Data Management

There is no indication of comprehensive data management (see above).

III. Conclusions

Groundfish monitoring is a large and complex enterprise. The FRAM staff have done heroic work with limited manpower to implement a program that is truly impressive. The staff have demonstrated high expertise and effort and deserve tremendous credit.

That said, the investment in effort has clearly advanced farther along some lines (e.g. specific sample collection) than on other lines (monitoring science & data management). A more structural approach to monitoring science is recommended with the intent to shore up some of the less advanced components of the groundfish monitoring program.

Northwest Fisheries Science Center Science Data Collection Program Review

Reviewer 4

I. General Observations

An independent review of the data used in California Current Groundfish stock assessments was held at the Northwest Fisheries Science Center (NWFSC) in Seattle, WA September 17-20, 2013. The primary objectives of the review were to examine the fishery independent and dependent data that support the assessments of groundfish of the California Current and to evaluate the:

- Relationship of current and planned fishery assessment data activities to fishery assessment mandates and requirements;
- Opportunities for the Center to pursue in collecting and compiling fishery assessment data, including shared approaches with partners;
- Fishery data adequacy and whether the best suite of techniques and approaches are being used;
- Organization and priorities of the Center's fishery data system to best to meet its mandates and the allocation of resources among program appropriate; and,
- Scientific approach used in the fishery data programs (survey design, standardization, integrity, peer review, transparency, confidentiality, PII, etc.)?
-

There are 91+ species of groundfish managed by the Pacific Coast Groundfish Fishery Management Plan for California Current (West Coast) groundfish. These species and the Management Plan span the three west coast states of California, Oregon, and Washington and also are impacted by management and fisheries for many of these species in Canada and Mexico. Pacific hake or whiting is governed by treaty with Canada. Within the U.S., data collection programs and stock assessments are shared between National Marine Fisheries Service's (NMFS) NWAFC and Southwest Fisheries Science Center (SWFSC), the three west coast states, and important coordination with the states provided by the Pacific States Marine Fisheries Commission (PSMFC). As a result, the task of collecting and providing the data needed for assessment and management of the West Coast groundfish stocks is large and complex.

The staff from the NWFSC and SWFSC and their state and PSMFC partners should be commended for their work and efforts to provide the fishery independent and dependent data needed to support West Coast groundfish stock assessments and

management. The presentations during the review clearly show the impressive extent and high quality of those efforts and the dedication of the staff involved. The data collection programs currently support the assessment of the 91+ species of groundfish to varying degrees and generally appear to meet the needs of the most important commercial species managed by the PFM. However, it is apparent from the presentations this past week that there are a number of areas within all these programs that need to be further examined and improved. The current and future uncertainty of budget, personnel and ship resources make it even more important that this is done. Cooperation and coordination between all the partners involved and from NMFS on a national level will be needed to accomplish this in an informed and effective way. My comments and recommendations on the specific programs reviewed follow. I want to thank everyone for allowing me to participate in this review.

II. Fishery Independent Data Collection Programs

Information on five fishery independent data collection programs was provided during the review; bottom trawl survey, acoustic-trawl survey, hook and line survey, juvenile rockfish survey, and the cowcod visual survey.

Bottom Trawl Survey: Of these five, the annual bottom trawl survey conducted by the NWFSC supports more stock assessments than any other fishery independent data source on the West Coast. This survey is a relatively new “time series” compared to similar trawl surveys conducted in other regions and its value will increase over time and it is important that it be continued. Staff at the NWFSC should be commended for the excellent job they have done in implementing and conducting this survey. That said, the questions and uncertainty of funding to support surveys make it important that the NWFSC begin to look at impacts on their stock assessments of reduced survey sampling density and survey frequency. This should be a high priority during the upcoming “off year” in the assessment cycle. As part of this exercise, NMFS should be encouraged to look at this issue from a national perspective since the NWFSC is not the only Center facing this issue. Alternative ways to secure support from industry or use of the sale of research quota that can be used to cover costs of charter ship time should be investigated.

This large and important survey is staffed by a minimal number of FTE’s at the NWFSC. When one considers the time needed to plan, conduct, and provide survey results every year, it is hard to see how that same staff can address the survey sample design, frequency, and impacts of untrawlable habitat issues that need to be dealt with. It is recommended (as with the acoustic trawl survey discussed below) that the NWFSC and SWFSC look at ways to jointly address this issue. It was noted that within FRAM there is a current vacancy (Newport Program Manager) unfilled due the hiring freeze. Filling of this position with an individual who can bring the analytical expertise and leadership to the bottom trawl and acoustic survey programs is important. The right individual can help both of these key data

collection programs address the sample and survey design questions and also instill additional science within those programs.

The utility of the annual west coast bottom trawl survey is impacted by the large percentage of the survey area that is not suitable to be sampled by trawls. Efforts should continue and be expanded to more fully map and identify the untrawlable habitat. Partnerships with other agencies (USGS) and use of current survey ships (both charter and *Shimada* and *Lasker* ME-70) should be pursued to do this. The NMFS Office of Science and Technology national effort to investigate and develop alternative technologies that could be used to better survey these areas and process the resulting data should be fully supported. An important part of this process is development of the methods that will be used to incorporate these new methods into future assessments and being able to show what their impacts on those assessments will be (i.e. it is important that stock assessment staff be fully integrated in these efforts).

Acoustic-Trawl Survey: The acoustic-trawl survey conducted from the NOAA ship *Shimada* supports the assessment of the single most valuable groundfish species on the West Coast. As with the bottom trawl survey the staff at the NWFSC should be commended on the manner in which this survey is conducted. Like the bottom trawl survey, it appears that this survey is supported by a minimum number of FTE's and the two science centers should look at ways to jointly use their resources to address this issue. Both science centers have acoustic groups and their interaction and cooperation has increased since the combining of the hake and sardine surveys in 2012. Hopefully the level of integration and cooperation will continue and grow. It is unclear whether the combined hake/sardine survey will be continued as a joint survey. The planned CIE review of the joint survey in 2014 is a good way to review this issue and provide important input to the two science centers in evaluating the benefits of a combined survey vs. separate surveys. Based on comments during the review it appears there may be concern over continued Canadian participation in this survey. Identification and evaluation of what alternatives exist to backfill the Canadian effort if the Canadians have problems in fulfilling their treaty commitments should be initiated.

During the review of the acoustic-trawl survey questions arose on why the assessment time series began in 1995 and the status of acoustic survey data prior to that. Although the decision made jointly by U.S. and Canadian scientists may be appropriate, recovery of the historic acoustic survey data would seem to be a worthwhile goal so that those data would be available for future use. The question of ship calibration was also brought up and although the difficulty of completing a calibration between the *Shimada* and *Miller Freeman* is understood it doesn't mean that questions about fish reaction to the new ships and calibration between ships aren't still important. Additional research in this area should be conducted to at least determine if ship calibration is an issue. New tools such as the acoustic buoy developed by the Alaska Fisheries Science Center and used during the calibration of

the *Dyson* and *Miller Freeman* can be employed to look at questions of hake and sardine response to the ships used in the survey.

Hook and Line Survey: The hook and line survey that was initiated with a pilot survey in 2003 provides data used in the assessments of several rockfish species in the Southern California Bight (SCB) from areas that cannot be sampled with trawl gear. The survey appears to be well designed and has proven useful in providing indices of abundance for several species. This is a fairly low cost survey and might be a survey worth expanding within that area and similar areas along the coast. A CIE review of the survey was conducted in 2012 and it appears that some of the questions raised by reviewers regarding hook saturation and design still need to be fully examined.

Juvenile Rockfish Survey: The juvenile rockfish survey has been conducted at various spatial scales by the SWFSC since 1983. Since that time, the survey has expanded in the area covered, included a cooperative survey conducted by the Pacific Whiting Cooperative and NWFSC, and expanded in 2013 to the entire west coast as a cooperative effort between the SWFSC and NWFSC. The data from the survey has been used in the assessments of eight rockfish species over time and also serves as an important study of the effects of physical and biological factors on rockfish recruitment. Since the results of the coast wide survey conducted in 2013 are not yet available, the utility of the full expansion of this survey is yet to be determined. Completion of those analyses and how they may be used in the next assessment cycle will be important in deciding the future of the survey. Until those analyses are completed, decisions on the continuation of the coast wide survey or return to the more limited survey coverage prior to 2013 need to be made. My sense is the full survey should be continued if adequate ship and other personnel and fiscal resources are available. An additional year of coast wide data will further help in determining the long term utility of the survey. This survey has been conducted from both NOAA and chartered ships in the past. However, because of the broad array of biological and oceanographic data collected during the survey this is a survey that is most effectively conducted from an FSV if there is sufficient NOAA ship time available.

Cowcod Visual Survey: The cowcod visual survey is an outstanding example of a survey using non-trawl visual methods and that also incorporates the habitat occupied by the primary species into the survey design and resulting assessment. The initial survey was conducted in 2002 and then repeated in 2012. The presentation demonstrated how the survey results were incorporated into the assessment of cowcod and their impact on the assessment. It is a relatively low cost survey but currently only focuses on one species although there is potential for use for other rockfish species occupying similar habitats that cannot be sampled by trawls. It may also be a survey that can focus on different areas and species that can be repeated on a rotating schedule as has been done with cowcod thus keeping the annual cost relatively low. There are challenges in terms of adequate mapping of habitat that can be addressed with efficient use of the ME-70 multibeam systems on

the new FSV's while those ships are conducting other activities and partnerships with other agencies. Issues relating to the processing and archiving of visual data and availability of appropriate vehicles are areas being addressed by the NMFS advanced technology initiatives. The survey provides an excellent example of how NMFS should pursue and evaluate the use of advanced technologies to support stock assessment.

III. Fishery Dependent Data Systems

Fishery dependent data for West Coast groundfish come from commercial and recreational fisheries and are collected through the use of federal, state, and fish commission programs. The number of partners involved and varying levels of support for these programs make this a difficult task. The two large advantages that help offset these difficulties are the NWFSC's broad and well managed fisheries observer program covering the commercial fisheries coast wide and the active role played by the PSMFC in coordinating and supporting collection of commercial fish ticket and port sampling data from the three states and to a lesser degree coordination of data from recreational sampling. All of these data are of great importance to the assessment of West Coast groundfish stocks.

State Commercial and Recreational Catch Data: All three States have programs that collect commercial and recreational data from fisheries conducted off their coasts. The data collection capabilities and sampling extent of these programs vary by state and the PSMFC plays a critical role through PacFin and RecFin in coordinating collection of these data and making these data available for stock assessment use. Those working with these programs in the states and at the PSMFC should be congratulated for what they have accomplished. My sense is that collection and access to these data is better than most other areas of the country. However, continued funding support by each of the states and the federal government is a large concern on the future of these programs.

Within the commercial fisheries the implementation of the IFQ fisheries has led to greatly improved reporting and monitoring of catch that provides information in a real time way. However the non-IFQ portion of the fishery is still large, sampled at varying levels, and each of the states faces challenges in collection of data and providing that data to PacFin for use in assessments. I would encourage further work between the states and the PSMFC to standardize as much as possible the collection and reporting of catch, effort, and biological data from the non-IFQ fisheries.

All three states also collect and provide data via PSMFC's RecFin on the recreational catch and effort. Some excellent examples of collection of these data were presented. Two of note was the use of observers to sample the charter fishing fleets in California and Oregon and Oregon's innovative approach using a combination of video and port sampler observation to measure private boat effort. Collection of data from the recreational fisheries is extremely difficult because of the large

numbers of individual participants, differing data collection statutes between the states, and sport fishers' attitudes in allowing their catches to be sampled and providing information. A need to bring the structure and design of RecFin up to date was identified and should be pursued. Several comments were made that it is better to go to the states for data on recreational catch than RecFin indicating work on RecFin is needed. Other than that, I encourage the continued cooperation, exchange of information on best practices and standardization of data collected and methods to the greatest extent possible across the three states. The PSMFC provides the forum to do that.

West Coast Groundfish Observer Program: The Observer Program that has been implemented for West Coast federal groundfish fisheries is impressive. The program provides 100% coverage of the IFQ and at-sea hake (really 200% in this case) fisheries and varying levels of coverage of other groundfish fisheries. Data are used for both in-season management of individual and fleet quotas and for providing catch, effort, and biological data for stock assessment purposes. The NWFSC has done an excellent job in the oversight and management of this program. As with many of the other data collection programs, the Observer Program is a partnership between the NWFSC, PSMFC and the fishing industry. Data from the Program is available in a timely way for in-season catch management but there are issues associated with the combining of PacFin catch and observer data on discards on a haul by haul basis at the end of the year that prevents the second year of catch data from being used in the biennial stock assessment cycle. This situation as with other data management issues experienced by the other data collection programs needs to be addressed.

A second and larger issue of concern raised during the review is the possibility of the loss of the spatial and temporal data provided by observers on catch, effort, and biological data in the IFQ fisheries as the level of discards within the fishery decreases. The NWFSC should begin looking ahead to what will be done if continuing decreases in discards degrades these data and what options will be available to obtain this information via either reduced levels of mandatory observer coverage or expanded sampling of the retained catch at sea before delivery shoreside. The ability to more effectively use sampling in the Observer Program to address needed biological data collection should also be pursued (See Biological Sampling in the following section).

IV. Biological Sampling: The PSMFC operates a Cooperative Aging Program (CAP) in Newport, OR that is supported by funding from the NWFSC. The CAP ages samples from California, Oregon, and surveys conducted by the NWFSC while Washington ages their own samples. Ages from the state samples are entered by the states into PacFin while ages from NWAFC surveys are maintained in their survey databases. Use of the CAP provides a good way to coordinate aging of age structures collected from the commercial fisheries and has been a good partnership between the states, NWFSC, and PSMFC. Samples to be aged from a given assessment cycle

are identified through discussions between the assessment scientists and the NWFSC and CAP. A more rigorous analysis of the effect of numbers of ages on the assessment outcomes should be conducted to better manage this process. Of greatest concern are the impacts of reduced federal funding on the CAP. The analyses of the sensitivity of the stock assessments to the numbers of aged fish will become even more important if the CAP staff is reduced.

There is great ability to collect a broader suite of biological, environmental and oceanographic data through the combined efforts of NMFS surveys, observer program, and state commercial and recreational data collection programs. The importance of appropriate sampling design and evaluation of required sample levels is something that is needed in these programs to make the most efficient use of sampling resources and time. It is possible to use the observer program and possibly state sampling programs to improve collections of maturity, food habits, and genetic data. The NWFSC should be encouraged to identify and prioritize needed data collections to support their stock assessments and identify the most efficient way to utilize the full breadth of data collection programs to make the needed collections. One way to do this is to form Species Working Groups where assessment scientists and the data collection programs work together to identify the most pressing biological data needs and then develop a plan to collect those data via the appropriate data collection program.

V. Emerging Technologies: The use of emerging technologies is important to both improve the science supporting our data collections and identify potentially more cost effective means of providing the data needed for stock assessments. Within NOAA a major driver behind the efforts to develop and utilize new technologies is the desire to reduce and more effectively use available ship time. A number of projects involving the development and use of new technologies were highlighted during the review. All offer promise. The use of visual data collected during the cowcod visual survey offers an excellent example of how a new technology can be employed and used to improve an assessment. This particular survey is a good model to use in evaluation of other technologies and methods being investigated. Until recently, development and testing of new technologies within NMFS has been done at a regional science center scale with individual science centers pursuing projects funded by the national office. Although there will be continued limited support of individual regional projects, the current effort within NMFS to focus on two major national initiatives will hopefully utilize the overall expertise and successes in the agency and lead to results that address broad areas of need nationally.

VI. Data Management

With almost all of the fishery independent and dependent programs described this week, issues relating to data processing, management and access were apparent. This needs to be addressed in a comprehensive fashion for survey, commercial,

recreational, and observer data. It appears there is a comprehensive plan possibly funded via the Moore Foundation to address much of this. This opportunity should be energetically pursued since it impacts the ultimate utility of the data for both short term (in-season management) and long term uses of these valuable data. The need doesn't end there since the NWFSC and SWFSC will then be responsible for maintaining those systems. There appears to be a lack of adequate staff with the expertise needed to develop and maintain data systems in the science centers and this will have to be addressed by all the partners as this work moves forward.

VII. Conclusions

It was a pleasure to be part of the review of groundfish data collection programs and I want to again say how impressed I was by the quality and level of work being done by the NWFSC and SWFSC and their state and PSMFC partners. This is a large and complex effort. My specific observations and comments are provided above and following are several general conclusions and recommendations based on the review.

1. **Survey and Sampling Design.** There is a general need to statistically evaluate survey design and sample collections. Except in a few cases, the information provided during the review was inadequate to access that and I expect this comment applies more generally to NMFS data collection programs as a whole. The questions of adequate levels of sampling become more important as funding for these activities becomes more limited. These types of analyses are needed to make informed decisions on what can and can't be modified and to identify impacts on stock assessments for your constituents as changes are proposed and made.
2. **Staffing and Resourcing.** The fishery independent (bottom trawl and acoustic surveys) and dependent (observer program) data collection programs of the West Coast are enormous undertakings. From a reviewer's perspective, while the observer program seems to be adequately staffed it appears the bottom trawl and acoustic survey efforts are minimally staffed. Surveys get conducted and data provided but the ability of staff to be able to address the sampling and survey design questions mentioned above is limited. Under current budget and FTE limitations it will be difficult for the NWFSC to address this issue on their own. Assessment of West Coast groundfish is a responsibility of both West Coast science centers. There is an expressed commitment to partner between the two science centers and they should be further encouraged to see if there are additional ways to share their combined resources to address the data collection needs for these programs.
3. **Ship Time.** All of the fishery independent data programs are dependent on either NOAA or charter ship time. Both types of platforms are becoming more costly and with flat or reduced budgets something has to give. In the case of charter ships, there may be alternative mechanisms to obtain the needed ship time that should be explored. Cooperative efforts with industry

foundations or use of research quota may provide a means to provide the needed time. The alternative is to begin to reduce the frequency and scope of the time series surveys that have supported stock assessments and also prevent or greatly limit the implementation of new/improved data collection programs.

4. **Data Management.** As stated above, almost all of the data collection programs reviewed this week identified issues with management and dissemination of data. This needs to be addressed in a comprehensive fashion for all areas of these programs.

Northwest Fisheries Science Center Science Data Collection Program Review

Reviewer 5

The objective for this review is to review and evaluate the Northwest Fishery Science Center's current scientific fishery-dependent and fishery-independent data as they relate to fishery stock assessments conducted pursuant to the Magnuson-Stevens Act. In preparation for the review meeting, reviewers were tasked with reading 27 primary documents with an additional 95 documents recommended for further reading. NWFSC staff gave thorough presentations and led discussions for the first three days, leaving the fourth day for reviewers present and discuss their findings. The topics raised in this report generally follow the chronological order of the topics as presented in the meeting but with an additional section to cover the broader, more cross-cutting issues.

Overview and General Observations

The NWFSC staff undertook the herculean effort of summarizing information for a large range of fishery-independent and fishery-dependent data collection programs. Their presentations were thorough, well-organized, and very detailed. Nearly every presentation included helpful information on that data program's strengths and challenges as well as concrete recommendations for possible changes in data collection or management that would increase the usefulness of that data.

Unfortunately, I am only able to comment on how improvements or changes to data collection and management would affect stock assessments in the broadest of terms because the information relative to that question was hardly if ever provided. While the "Data Matrix" was incredibly useful for determining which data were related to which assessments, it did not provide specific ways in which improvements in the data would improve the output of the assessments. While power analyses that explore the sample size – precision trade-offs for a particular piece of data (e.g., estimate of bycatch from a particular fishery) would be useful for discussing how to improve the data, they do not tell us how that change in precision affects the assessment, which was the task of this review. Similarly, without a formal analysis, it is impossible to determine how changing the frequency of surveys (e.g., twice per year, once per year, once every two years) might affect even one stock assessment, let alone multiple assessments, as would be the case for the multi-species trawl fishery. NWFSC should initiate a study to explicitly explore the ramifications of changes in survey frequency on the full range of assessments for which they have responsibility.

In leading up to this review, there were a number of analyses that could have been undertaken to answer the question, "To what extent do fishery-independent or fishery-dependent data quality, statistical precision, and timeliness issues impact

overall assessment accuracy and precision?” Most, if not all, stock assessments include a set of sensitivity runs to explore how the assessment results change with either the removal of specific data or changes in specific parameters. A meta-analysis based on currently-existing sensitivity runs could be undertaken to summarize how the accuracy or precision of stock assessments change with the removal of specific surveys or changes in specific biological or fishery-related parameters. This would help the NWFSC determine which data are most central to the currently assessed stocks and determine how improvements in accuracy or precision in specific biological or fishery-related parameters might improve stock assessments. When specific data are available for a stock assessment but not included in the assessment, the assessment document typically gives specific reasons why they were excluded (e.g., lack of spatial coverage or representativeness, limited length of time series, high CV) and often includes specific recommendations on how that data could be improved so that it may be included in the future. Performing a formal analysis of the recommendations from the assessments, as well as the justification for excluding data sources, (e.g., via content analysis) could lend insight into what changes to which data sources would have the widest impact on assessments. Additionally, tracking which recommendations were actually implemented would also help the NWFSC determine how improvements in data affect stock assessments. Finally, performing a series of simulation-estimation exercises could also help the NWFSC examine the importance of data accuracy and precision for their assessments, but linking these exercises to real-world data sources may prove challenging.

Even if we did have information on how specific changes to data collection and management would affect specific stock assessments, we would only be able to address questions like, “What recommendations do you have for prioritizing fishery-independent and fishery-dependent data collection improvements?” in the very broadest of sense. The problem lies in the absence of clearly defined objectives. Without defined objectives, we cannot say what is better or worse. We cannot even define “good enough.” Is it better to reduce the uncertainty in the estimate of abundance for an economically and ecologically valuable, well-assessed stock (e.g., hake) or is it better institute data collection to provide even a minimally reliable estimate of abundance for an FMP stock whose ACL is currently being estimated using a catch-only (ORCS) method? Similarly, how often do individual stocks actually need to be assessed – especially if they are for long-lived, slow-growing species? It depends entirely on your objectives.

Formally defined objectives become especially important when trying to balance the needs of current assessments versus the needs to understand present and future population-level and ecosystem-level processes. The NWFSC needs to think creatively about how it would answer, in 10 or 20 years from now, the question “what data do you wish you had started collecting around 2013?” From what I could tell, the implementation and continuation of process-level studies has thus far been fairly ad-hoc. The data the NWFSC fails to collect now is going to be what limits its ability to apply new statistical methods in the future and therefor limit the

information available for things like ecosystem-based management. Tools such as MSVPA are already being used elsewhere to help explore how predator-prey relationships may affect natural mortality estimates that go into stock assessments. Without adequate data on consumption rates and habitat selection, such methods cannot be used. Similarly, the absence of process-level data may impede the NWFSC's ability to apply even single-species stock assessments as ocean temperatures, currents, etc. change with the changing climate. The NWFSC must give serious consideration and hopefully outline concrete objectives for to how it is going to balance the current assessments' data needs with the data needs for future assessment and management paradigms. Filling the currently vacant position to lead the survey program would definitely help in this endeavor and help guide future improvements. Filling this vacancy should be a top priority.

Another common theme in the Terms of Reference was timeliness. However, it was unclear as to which improvements in timeliness would actually lead to improvements in stock assessment accuracy, precision, or timeliness. From what I could tell (and I could be wrong) increasing the timeliness of the estimates of bycatch would do the most to improve the timeliness of assessments. One way to explore how changes in data collection from one source affect the timeliness of assessments would be to create a data flow diagram, which is similar to the data flowchart we saw in the presentations but includes more specific data and a temporal component (similar to a Gantt Chart.) This would allow NWFSC to explore how increased or decreased timeliness in one data collection or processing program trickles down through the entire process to inevitably affect the stock assessment. Such an exploration will be crucial if NWFSC hopes to anticipate where future bottlenecks may arise as data collection programs become more automated. When done at the finest scale, such a data flow diagram will also help NWFSC determine how increases / decreases in one aspect of data collection (e.g., maturity data from the trawl survey) may affect the collection of other forms of data (e.g., otoliths or stomachs).

There was also considerable discussion on the perceived pros and cons of the two-year, on-off assessment cycle. While this schedule does allow the assessment scientists to focus exclusively on assessments for a period of time, and then reserve the remainder for other research projects, it is uncertain as to whether this is actually the most efficient structure if one wishes to integrate research projects and personnel across multiple divisions at the NWFSC. Having a more constant stream of assessments, simultaneous with other research projects, may promote a more creative, integrative atmosphere. Regardless of the frequency assessments, the fact that the assessment schedule is determined well in advance and is not subject to last-minute changes is of utmost importance in keeping the assessment teams on track and not overburdened.

Finally, I wish to further emphasize that all comments and suggestions are in reference to data collection, management, and quality with respect to stock assessment, as per the terms of reference. A survey or datastream that has a low

impact on stock assessment may be crucial for other aspects of fishery management. For example, improved timeliness may greatly increase the regional office's ability to monitor landings relative to the ACL even if it does not improve the assessment. A survey that currently contributes only minimally to stock assessment may be crucial for ecosystem or process-oriented studies. Changes in data collection that would improve economic analysis or help managers better understand fishermen's response to management actions are not considered here.

Fishery-independent Data

One of the common themes throughout the meeting was the need for fishery-independent data from untrawlable habitat. One of the first steps to achieving that, however, is a comprehensive, fine-scale map of untrawlable habitat. There are likely many organizations undertaking various aspects of such a mapping exercise (USGS, universities, etc.), and it would be best to coordinate these efforts for the benefit of all involved parties. Given the potentially large area that is untrawlable and the importance of that habitat for many priority species, mapping and surveying this habitat should be a high priority.

One of the common complaints we heard throughout the discussion of fishery-independent data was the difficulty of securing ship time – whether they be NOAA vessels or charter vessels. I know others on the panel had very strong feelings about this, so I will not go into too much detail here, but I do want to state that I completely agree with the sentiments they expressed. When a survey is conducted using a NOAA vessel, having the same vessel available each time the survey is run would improve the precision of the data collected because inter-vessel calibration (which appears to be rarely done in the field and is mostly done by statisticians at the computer) could be avoided. This would also make the logistics of the surveys much easier. For the surveys being run with charter vessels, NWFSC needs to start thinking about how it will run these surveys as the charter vessels become more and more expensive (as they have been). Alternative funding methods need to be explored.

West Coast Bottom Trawl Survey

One of the larger concerns regarding the West Coast Bottom Trawl Survey focuses on how decisions were made as to what types of samples (otoliths, maturity, stomach contents, etc.) were collected when, nor how many were collected. For the most part, it seemed ad-hoc in that there was no formal analysis determining just how many of each type of sample was needed and what the trade-offs were for increasing the collection of one type of sample over another. As stated above, NWFSC should undertake a formal objective-setting exercise where they can directly examine the trade-offs between collecting different types of data for the various current stock assessments as well as data necessary for longer-term, more process or ecosystem-level analysis they will wish to undertake in the future.

Data management was another concern with this survey. I know another reviewer with far more expertise than me in this area will be writing extensively about this, so I will not go into detail here. But, I completely agree with the comments made during the meeting about the importance of instituting formal data management and “data husbandry” protocols. It sounds like a great deal of time is spent handling data requests – improved data management will help alleviate that stress and allow those involved with the survey to become more involved in the science. Including those responsible for the survey directly in the science should be a high priority, and the ongoing efforts to do so should be encouraged.

Hake Acoustic Survey

I know another reviewer will be writing at length about this survey, and I agree with what he said in the meetings, so I will keep my comments brief. Vessel standardization or inter-vessel calibration needs to be formally examined. NWFSC needs to do a thorough assessment to determine if combining the hake survey with the sardine survey is worth the costs in terms of statistical precision and accuracy, the loss of oceanographic data collection, and the morale / exhaustion of the survey personnel. This ties directly in with the issue of vessel time mentioned above. It sounds like the NWFSC has begun such an assessment, and I encourage them to continue these efforts. The NWFSC should also ensure that data are collected and managed in such a way that as new geostatistical methods are developed and become available, these can be applied to the full time series of survey data. The NWFSC should be anticipating that methods will continue to change and ensure backward compatibility of all datastreams.

Southern California Hook and Line Survey

The Southern California Hook and Line Survey has undergone extensive peer review through the Center for Independent Experts, and I encourage the NWFSC to give very strong consideration to the recommendations made in those reports. The potential problems of hook saturation, interspecies competition, and the fixed stations’ inability to capture range expansions or shifts are all concerns that need addressing. These issues will become especially problematic as different species recover at different rates. I was also surprised to see that the hierarchical structure of the data (hooks nested within sets nested within stations nested within areas) was being completely ignored in the analysis of the data. This is pseudoreplication and needs to change.

While this survey is a good method for sampling untrawlable habitat, I think there needs to be greater exploration of the true usefulness of the survey. From my understanding, to make it (more?) useful to stock assessments, the range of the survey needs to be expanded. Before that is undertaken though, I wonder if similar data can be collected through other means that might not be as susceptible to the gear saturation and interspecies competition issues. For example, in California,

observers are placed on Commercial Passenger Fishing Vessels (CPFVs) and from what I understand the data is spatialized such that comparisons between CPFV species composition and CPUE could be compared to the hook and line surveys from the same locations. The CPFVs will not likely suffer as much from hook saturation and will have a greater range. If similar data is being obtained, and it is reliable, then perhaps expansion of the CPFV observer program would do a better job of sampling while also accomplishing other NMFS goals of monitoring and interacting with recreational fishermen.

Juvenile Rockfish Survey

The Juvenile Rockfish Survey is an excellent example of how collaborative research can greatly expand the impact and usefulness of data. While its use in stock assessment, in terms of providing indices, may currently be limited, it is providing information that may be useful for assessment scientists even when the survey is not directly incorporated. For example, this survey helped demonstrate the temporal correlation of rockfish recruitment across fished and unfished species – highlighting the potential dominant role of environmental drivers in recruitment, as opposed to spawning biomass. Expanding this survey to be a coast-wide survey may also make this survey more relevant to more assessments by increasing the number of species captured. This survey is another instance of where the lack of reliable vessel time and the influence of vessel effects may decrease the precision of this data over time.

Cowcod Visual Survey

The cowcod visual survey is a great example of using alternative technology to obtain an absolute estimate of abundance. We heard that this estimate provides an important anchor in the assessment for the longer time series of relative abundance. The optimal frequency of this survey will depend entirely on the life history (growth rates, generation times, etc.) of the species in question and the needs of managers. The reliability of this estimate, however, depends entirely on the extrapolation of the surveyed areas to the coast-wide population. This extrapolation requires comprehensive, fine-scale, and accurate maps of habitat. Errors in the habitat-based extrapolation will propagate directly into the assessment due to the assessment's extreme sensitivity to these data. The time necessary to undertake the survey and fully analyze the data (a total of approximately one year) may cause issues with the timeliness of assessments, but combining this information with other indices of relative abundance may alleviate this problem. It was also emphasized in later discussion that visual surveys do not collect any parts for aging, maturity, or diet; so they cannot substitute for other types of surveys unless they are paired with other survey technologies.

Fishery-dependent Data

Representatives from Oregon, Washington, and California gave very informative presentations on the extensive data collection efforts of the state agencies. A few common themes and issues arose, along with some state-specific problems that need to be addressed. One potential issue is the lack of consistency in trip ticket forms, codes, etc., but this can be dealt with through relational databases at the Pacific States Marine Fisheries Commission. However, state-to-state consistency would be better. Also, all fish ticket forms should allow multiple gears and locations to be listed on the tickets. A larger issue is the lack of consistency across states for determining the catch composition for the various market categories (known as borrowing). These methods should be standardized to ensure that the most reliable data is entered into stock assessments. This consistency will also better allow scientists to determine how changes in sampling will affect uncertainty in the catch compositions, and therefore affect the stock assessment. Increased coordination between federal ITQ catch monitors and port samplers could also improve data quality.

There is a mismatch between the data collected by PacFIN and the data that would be most useful for estimating fleet-wide discard mortality for the stock assessments. The data from observers allows scientists to examine the role of factors such as location and depth to best parameterize models of bycatch mortality. However, these models can only be applied to the fleet when all those data are available fleet-wide. In the absence of such data, fleet-wide bycatch mortality estimates will be less precise and possibly even less accurate, and this may have significant ramifications for the stock assessment. Increased spatial data (through VMS, logbooks, etc.) will likely lead to improvements in bycatch mortality estimates that will then improve the reliability and precision of stock assessments.

In California, fishermen and processors are allowed to refuse samplers' request to sample their catch. This could be creating huge data gaps and biases and should be changed immediately. Compliance with the sampling of their catch should be mandatory. Also, the sampling of catch (either directly or via phone / mail / etc.) from private fishing vessels (non-CPFVs) is woefully inadequate in California despite the fact that it may constitute a major source of mortality for some stocks.

All the state representatives expressed misgivings about using the RecFIN data provided by the PSMFC. All of the representatives claimed that recreational landing data should be obtained directly from the states due to problems with the PSMFC's database. This needs to be rectified.

The databases and search capabilities of all databases at PSMFC need to be upgraded so that data across programs can be linked, made accessible, and reliably queried. I understand that efforts are already underway in this respect, and these should be encouraged and supported. Ideally, these databases should be designed so that observer data from a trip can be linked directly to the trip ticket data, and the biological samples taken from either observers or port samplers can be linked to both.

For the observer program, one of the main issues appears to be that of data management. The move to electronic data collection by observers should be encouraged, as should be the efforts to automate the linking of observer data with trip ticket data. Also, variability in funding appears to have led to variability in observer coverage for the non-ITQ fleets, which in turn will lead to decreased precision in the data for assessments. Stabilization of the funding would hopefully improve this.

Biological Sampling

The vast majority of biological samples are processed by the PSMFC lab, which is largely funded by a grant from the NWFSC. It is important to ensure that these funds remain secure in order to allow the continued processing of this crucial data. As with the other forms of data, the data management protocols for the biological samples need to be improved to allow for linking of samples directly to their trip / observer data. As fishermen learn to better avoid discards, the biological samples from these non-target fisheries will become more and more difficult to obtain. The NWFSC should begin developing contingency plans to deal with these changes that are already beginning to occur in the fishery. Finally, as stated above, the NWFSC needs to develop concrete objectives and conduct formal analysis to help set priorities for the collection and processing of biological samples across species, sample type (otolith, maturity, stomachs, etc), and collection platform (fishery independent surveys, observers, port-side samplers, etc).

Conclusions

The NWFSC is doing a fantastic job, especially given their very limited resources! However, it could benefit from a more formal approach to setting short- and long-term objectives for their data prioritization; a more formal analysis of the flow of data through their entire collection and assessment process to determine the effects of changes in surveys or data collection on the assessments; and a focused effort on improving upon the full range of data management issues, an effort that will be greatly enhanced by filling currently vacant leadership positions.